Inventions & Innovation Project Abstract

Innovative Combustion Pressure Sensors

Orbital Research proposes continued (Category 2) development of an innovative combustion pressure sensor that will result in dramatically reduced emissions of NOx and particulates. It is expected to do so without a fuel economy penalty, and with fuel savings of as much as 3%. The sensor proposed here is based on shape memory alloy technology, fabricated using MEMS techniques, and is expected to allow that goal to be met. The key to the technology is the simplicity of both the underlying technology and of its fabrication. The simplicity results in a cost/price point that conventional pressure sensor technologies cannot approach. This will allow pressure sensors to be economically installed in every cylinder of every diesel engine (and eventually every internal combustion engine). This will allow an unprecedented level of control over each individual combustion event, essentially a continuous tune-up for the engine, achieving optimal power from each stroke for best fuel economy and optimal temperature profiles to minimize the emissions.

The sensor itself takes advantage of the phase change behavior of shape memory alloys. By straining the element (through applied pressure on a diaphragm) a metallurgical phase transformation occurs. The child phase, which is produced under strain, has a much lower electrical resistivity than the parent phase. This results in a very high signal to noise ratio and thus minimal amplification is required, reducing the cost of support electronics.

During this program new packaging will be designed and tested to house and integrate the sense element. The current packaging is appropriate for large engine applications (e.g. marine diesel engines), but is not appropriate for the vast majority of off-road and over-the-road engine applications: robustness and reliability must be enhanced. The active sense elements have already been size-optimized for incorporation into the smaller diesel engines. In this program, the packaging will be further developed to ensure that the benefits that are possible are indeed attained.

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